Project Subject/Title: Northern White Cedar Site Prep Treatments
County: Douglas
TRS: T45N, R11W Sec. 8

Contact Person: Colleen Matula, 715-358-9208 (Principal investigators were Bill Johnston (USFS, Grand Rapids, MN) and Klaus Puettman (UM-St. Paul).
Type Of Prescription: Site preparation
Year Initiated: 1980

Abstract/Prescription:
The study area is located in the Brule Bog of the Brule River State Forest. The site preparation techniques were randomly assigned to 3 clearcut units. The site preparation techniques included slash removal by broadcast burning, full tree skidding, and full tree skidding leaving slash behind. The units were first clearcut in the winter of '79-80. The skid treatment equipment used was rubber tired skidder. The leave treatment left slash in place. The burn treatment slash was left evenly distributed with slash free alleys. Density of cedar, balsam fir and black spruce was sampled at 3 and 5 years. Regeneration was sampled on fifty 4 meter plots for each treatment. Seedbed types were defined and vegetation was sampled. Hare, deer and rodent exclosures were established.
Results:
All seedbed types (Burn-type bryophytes and Sphagnum moss) were adequate to produce enough seedlings to regenerate a fully stocked cedar stand. Burning actually increased the frequency of the Burn-type bryophyte seedbed while skidding increased the frequency of sphagnum moss. The burned treatment had the highest density of northern white cedar among the different site prep methods. Burning, however, eliminated most of the advance conifer regeneration.
Severe browsing on northern white cedar was documented throughout the study. Deer were the main herbivores, however, hare and other rodents contributed to the damage. Balsam fir took advantage of the reduced competition and increased in all treatments. All exclosures were beneficial in protecting regeneration of northern white cedar.
Discussion/Recommendations:

- Burning eliminates advance regeneration
- Climatic factors can influence the success of cedar regeneration i.e. maintaining a moist seedbed.
- Need for browsing control methods integrating a variety of silviculture techniques to regenerate cedar.
- A suggested silviculture treatment is to clearcut small patches of cedar located adjacent or close to each other over a period of 5-10 years so eventually the entire area is completely cut. This method assumes that the deer would avoid the center of the clearcuts due to lack of cover thus thwarting browsing.

Site characteristics
Site Index: 30-42
See enclosed document

Site Preparation Treatments and Browse Protection Affect Establishment and Growth of Northern White-Cedar

Alaina Davis, Klaus Puettmann, and Don Perala

Northern white-cedar (*Thuja occidentalis* L.) is a valuable species in the Lake States not only for its qualities as a forest product but also for its importance as wildlife habitat. This species is especially critical in providing winter yarding and browse for white-tailed deer (*Odocoileus virginianus*) (Verme 1965). The northern white-cedar forest type is found mostly in humid climates characterized by short cool summers (Johnston 1990). Northern white-cedar is shade tolerant and competes well with its associates on rich, swampy sites with actively flowing mineral rich water. Of its common coniferous associates on moist sites, only balsam fir (*Abies balsamea* L.) is more shade tolerant, while black spruce (*Picea mariana* Mill.) and tamarack (*Larix laricina* Du Roi) are less so (Johnston 1990). Important factors controlling reproduction of northern white-cedar are adequate amounts of moisture, warm temperatures, and moderate light levels. Most regeneration occurs by natural seeding and layering. Layering takes place primarily on sites where the seedbed consists of moist organic material and often in areas with abundant sphagnum moss (Nelson 1951). On upland sites, northern white-cedar germinates well on seedbeds where fire has exposed mineral soil but has left some slash on the site. Seedbed conditions are improved by fire on lowland swampy sites when conditions for mosses such as *Heterphyllium, Pleurozium,* and *Brotherela* sp. are improved (Johnston 1990).

A major concern for northern white-cedar management is the lack of sufficient regeneration after harvesting (Johnston 1977). Factors that can hinder reproductive success of northern white-cedar include inadequate seedbeds, competition with faster growing or more shade tolerant associates, and browsing from deer and hares (*Odocoileus virginianus* and *Lepus americanus*) or other rodents (Johnston 1990). Balsam fir can replace northern white-cedar in mixed stands because it is more shade tolerant and because it is not a preferred browse species. Moreover, balsam fir has less stringent seedbed requirements (Frank 1990).

Although decomposing logs can make good seedbeds for cedar (Holcombe 1976), large amounts of cedar slash left on site creates a barrier to seed germination because of its slow decomposition rates and rot resistance (Lanasa 1989). Competition from other shrub or woody species might also reduce northern white-cedar growth and survival in clearcuts (Verme and Johnston 1986). Another important factor in lower survival of northern white-cedar is the level of browsing that occurs. Browsing of seedlings has been attributed mostly to large deer populations, but hare and rodent populations have also been linked to browsing damage (Bookhout 1965).

Research on effective methods to control both balsam fir competition and browsing impacts on northern white-cedar has been lacking. We conducted a study to partly fill this gap by

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investigating (1) the effects of site preparation by fire and skidding on northern white-cedar regeneration and (2) the effects of deer, hare, and rodent browsing on height growth in northern white-cedar. The study is limited by the incomplete nature of measurements taken, but valuable inference can be gained from large differences among the treatments.

SITE

The study area is located on the "Brule Bog" of the Brule River State Forest near Solon Springs, Wisconsin (SE 1/4, NE 1/4, Sec. 8, T45N, R11W). Soil characteristics and site indexes for the study area are presented in table 1. The average annual temperature is 4.4°C, and the average spring (March through June) temperature is 7.5°C. The average annual rainfall is 780 mm, and the average spring rainfall is 226 mm. Conditions during the study period (Spring 1980), were warmer (average temperature = 8.4°C) and drier (rainfall = 156 mm) than normal. Advanced reproduction of balsam fir dominated the understory. The study area generally fits the V-22 Cedar (inc. Mixedwood)/Speckled Alder/ Sphagnum site classification (Sims *et al.* 1989). A list of the main associated species is presented in table 2.

Table 1.—*Site characteristics and stand conditions before treatment in 1980*

	Burn	Skid	Leave
Soil description			
Total depth (cm)	250-270	220-400	220-320
Texture of mineral substratum	*M	coarse sand to rock	gravel
Organic material	fibric, sapric	fibric, sapric	sapric
Stand Conditions			
Northern white-cedar			
Basal area (m^2/ha)	21.5	33.5	30.7
50-year site index (m)	6	6	6
Balsam fir			
Basal area (m^2/ha)	8.9	7.2	9.0
50-year site index (m)	12	14	14

*M = not measured

Table 2.—*Common associated vegetation on northern white-cedar study areas*

Alder	*Alnus* spp. Miller
Strawberry	*Fragaria* spp. L.
Grasses	*Poa* spp. L., *Calamagrostis* spp. Adans.
Labrador tea	*Ledum groenlandicum* Oeder.
Raspberry	*Rubus* spp. L.
Red osier dogwood	*Cornus stolonifera* L.
Sedges	*Carex* spp. L.
Willow	*Salix* spp. L.
Moss	*Sphagnum* spp.

METHODS

The site preparation treatments included slash removal by broadcast burning (Burn), full-tree skidding (Skid), and a full-tree skidding operation that left slash behind (Leave). These treatments were all compared with an uncut control (Uncut). Site preparation methods were randomly assigned to three completely clearcut units (8,600 m^2) and separated by two uncut, control units (5,665 m^2). Harvesting was completed in the winter of 1979-80; the few residual trees 5 cm diameter at breast height and larger were felled in October 1980. The Skid treatment used a rubber-tired skidder, and slash was burned progressively at the landing. The Leave treatment left slash in place. On the Burn treatment, slash was left evenly distributed between 10-m-wide slash-free alleys and burned in July 1980 under fairly severe conditions. Soil and site conditions were measured in 1979 and 1980 (table 1). Site index was estimated using dominant or codominant northern white-cedar and balsam fir in or near each clearcut unit. The depth and description of organic material were taken near the north and south end of each unit.

Density of northern white-cedar, balsam fir, and black spruce was sampled 3 and 5 years after burning (spring 1983 and fall 1985). New seedlings that established after the harvest and site preparation treatments were distinguished from advanced reproduction for northern white-cedar and balsam fir but not black spruce (Viereck and Johnston 1990).

Regeneration from 0.6 m to 2.0 m in height was sampled on fifty 4-m^2 plots for each site preparation and on forty-eight 4-m^2 plots for the uncut control. Reproduction that was less than 0.6 m tall was sampled on 1-m^2 subplots in 1983 and 1985. Seedbeds and associated vegetation were sampled on these same 1-m^2 subplots. Seedbeds were categorized into Sphagnum Moss, Burn-Type Bryophytes (fire succession mosses), Slash, Leaf Litter, and Others (Verme and Johnston 1986). The seedbed type that supported the greatest number of new northern white-cedar seedlings was also recorded on each subplot.

The effects of deer, hare, and rodent browsing on cedar regeneration were examined by establishing exclosures. Hare exclosures (Hare) were 1 m x 1 m in area and 0.76 m in height and made of 5.0-cm-wide mesh poultry netting, which did not exclude rodent browsing. The rodent exclosures (Rodent) were the same dimensions as the hare exclosures but were made of 0.6-cm-wide mesh poultry netting and excluded all browsing. Deer exclosures (Deer) were 1.8 m x 1.8 m in area and 2.4 m high. In November of 1980, each set of exclosures was built in areas with patches of northern white-cedar reproduction except the Burn unit where new seedlings were not yet present. Nearby areas with regeneration patches were selected as controls (Unfenced). Density and height of northern white-cedar reproduction for various combinations of site preparation methods and browsing protection treatments were measured in 1980, 1981, 1983, 1985, and 1990 (table 3).

Table 3.—*List of browse exclosure treatments by site preparation methods and year in which height of northern white-cedar seedlings was measured*

	Skid	Leave Slash	Uncut
1980	hare, rodent & unfenced	hare,rodent & unfenced	hare,rodent & unfenced
1981	deer, hare & unfenced	hare & unfenced	hare & unfenced
1983	unfenced	M*	unfenced
1985	deer, hare & unfenced	M*	M*
1990	deer, hare & rodent	hare & rodent	hare & rodent

*M = not measured